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The prothallium of *Kaulfussia* is said to be the largest among Marattiaceae, a very large one reaching  $2.5 \times 1.75$  cm; but the usual adult size is 1 cm or more in length and nearly as broad. An endophytic fungus is always present. The antheridia and archegonia, restricted to the ventral surface, are also of unusual size. CAMPBELL thinks that probably all the organs of the embryo of Marattiaceae, except the foot, are of epibasal origin, and he finds confirmation of this in *Kaulfussia*. As in other members of the family, the shoot pierces through the prothallium and emerges from the dorsal surface.

The prothallia of *Gleichenia* are also of the "massive-midrib" type, more or less lobed, and with an endophytic fungus. The antheridia are restricted to the ventral surface in all species except *G. laevigata*, in which they occur upon both surfaces. In the species examined they are larger and more complex than recorded in the species examined by RAUWENHOFF, the wall cells being much more numerous, several hundred sperm mother cells sometimes being produced, and an opercular cell probably always being present. The archegonia are more numerous upon the flanks of the "midrib" than upon its middle region; the necks are very long; and the neck canal cell (except in *G. polypodioides*) usually divides into two cells. The embryo, so far as the material permitted comparison, resembles that of the Polypodiaceae. The characteristic protostelic condition was observed in sporelings, but it was not discovered whether it persists in the adult form in all species.—J. M. C.

**Sexual reproduction in the rusts.**—During the last three or four years BLACKMAN and CHRISTMAN have described a process of sexual reproduction in the rusts. Their accounts are not in entire agreement, and so the ground has been traversed by OLIVE,<sup>13</sup> with an unusual wealth of material. About forty species were examined, and the most favorable form for the study undertaken proved to be *Triphragmium ulmariae* (Schum.) Link, on *Ulmaria rubra* Hill, a caecoma form similar to the species of *Phragmidium* studied by BLACKMAN and CHRISTMAN. The two fusing cells ("gametes"), as well as their nuclei, were found to be approximately equal, but for reasons given in detail it is concluded that they differ somewhat in time of development. The equality and sexual character of both the fusing cells are statements opposed to those of BLACKMAN. It is also concluded that the sterile cell (at the tip) is not an abortive trichogyne, but merely a "buffer cell" of the gametophyte. Conjugation takes place through a perforation developed in the contact-walls. It may begin through a very small conjugation pore (observed by BLACKMAN), but this is regarded as only the beginning of a larger perforation. In the study of the various vegetative nuclear divisions it was discovered that they are all mitotic, each nucleus during the conjugate divisions acting independently. These nuclear divisions, conducted with the aid of centrosomes, are described in detail; and in *Triphragmium* it was ascertained that the chromosomes are probably eight in number. The occur-

<sup>13</sup> OLIVE, EDGAR W., Sexual cell fusions and vegetative nuclear divisions in the rusts. *Annals of Botany* 22:331-360. *pl.* 22. 1908.

rence of one or more multinucleate cells at the base of certain young aecidia is considered, and the conclusion is reached "that they are sporophytic structures, and that they result from the stimulated growth which follows the sexual cell fusions." This is opposed to the idea (CHRISTMAN) that the "fusion cell" functions at once as a "basal cell" at the bottom of each row of spores.—J. M. C.

**Gnetales and Angiosperms.**—Last year ARBER and PARKIN announced<sup>14</sup> their "strobilus theory of angiospermous descent;" and now they have applied it to the interpretation of the relationships of Gnetales.<sup>15</sup> There is much to commend their general view, without conceding all the details cited; in fact the reviewer has long since reached the same conclusions as to the character of the strobilus of Gnetales, and has remarked upon its similarity to such inflorescences as those of the Amentiferae. The authors do not regard the Gnetales as a modern group, although at present unknown as fossils. The three survivors of this ancient group have "pro-anthostrobili,"<sup>16</sup> evident in the staminate "flower" of *Tumboa* and reduced in the other "flowers" of the group by the suppression of one set of sporangia. To the authors the strobilus of this group is the so-called "flower;" and the strobilus of current terminology is an aggregate of strobili. Based upon this strobilus situation, the authors regard Gnetales as a phylum of gymnosperms having a common ancestry with angiosperms in the hypothetical "hemiangiosperms," and in many respects following parallel lines of development.—J. M. C.

**Origin of angiosperms.**—LIGNIER<sup>17</sup> has discussed the recent paper by ARBER and PARKIN,<sup>18</sup> in which the origin of the angiosperm flower (of the Ranales type) is traced to the bisporangiate strobilus of Bennettitales. From this view LIGNIER dissents, as he regards the strobilus in question as representing an inflorescence rather than a flower. To him the intraseminal scales are not sterile carpels or sterile lobes of carpels, but bracts in whose axils the ovuliferous stalks appear. This strobilus, therefore, is a compound one, as are the ovulate strobili of many of the Coniferales and both strobili of the Gnetales. LIGNIER agrees to the idea that the Ranales type of flower is the most primitive, but he would derive it from

<sup>14</sup> Review in BOT. GAZETTE 44:389. 1907.

<sup>15</sup> ARBER, E. A. NEWELL, AND PARKIN, JOHN, Studies in the evolution of the angiosperms. The relationship of the angiosperms to the Gnetales. *Annals of Botany* 22:489-515. 1908.

<sup>16</sup> An "anthostrobilus" is an axis bearing microsporophylls and megasporophylls, with the latter above the former. A "pro-anthostrobilus" is the variety in which the pollen reaches the ovules (gymnosperm), the strobilus of Bennettitales being an example; while a "eu-anthostrobilus" is the variety in which the pollen is received by the megasporophyll (angiosperm).

<sup>17</sup> LIGNIER, O., Le fruit des Bennettitées et l'ascendance des Angiospermes. *Bull. Soc. Bot. France* IV. 8:1-17. 1908.

<sup>18</sup> BOT. GAZETTE 44:389. 1907.